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(54) IMPROVEMENTS IN AND RELATING TO ASEPTIC PACKAGING

(71) We, AB ZIRISTOR, a Swedish corporate body of Fack S-221 01, Lund 1, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the sterile packaging of fluent materials in containers, which are introduced into a tunnel. The invention is suitable *inter alia* for packaging dairy products.

In a known method for the packing of sterile goods under aseptic conditions in prefabricated containers, one or more containers is/are introduced into a chamber which is then closed. The inside of the chamber, the containers which have been introduced, and container-filling and closing elements inside the chamber are sterilized. When the chamber and its contents are fully sterilized a sterile material being packed is fed to the sterile container or containers, which is/are then closed and sealed. The closed and sterile chamber is then opened so that the loaded containers can be removed, whereby the sterility in the chamber and of the elements arranged in the chamber is lost. The procedure is then repeated again for the sterile filling of fresh containers. In another known system, prefabricated and sterile containers are punctured by a cannula, through which the sterile material being packed is introduced into these containers. This packaging system, like the one described earlier, is not acceptable for the packaging of such goods as food-stuffs.

With a view to improving upon these known systems, and providing a system suitable for the sterile packaging of edible products such as dairy products, the invention consists in apparatus for the sterile packaging of fluent material comprising a tunnel with a longitudinal gap in its base, an endless conveyor provided with apertures adapted to be sealed by containers tightly fitted therein, or with imperforate recesses or depressions for holding containers, which conveyor transverses said base gap of said tunnel with its edges in co-operation with the tunnel walls in order, when loaded with containers, to form a seal across said gap, aseptic screening means at spaced positions defining between them a closed sterilised space within the tunnel through which said containers are carried by said conveyor, said aseptic means at the entrance into, or additional means within, said space comprising means for directing a sterilizing beam of electrons upon said containers during or after entry into said space, means in said space for loading the sterilized containers with their intended sterile contents, and means in said space for closing and sealing the loaded containers before they are carried out of said space through the other of said aseptic screening means.

One embodiment of the invention, given by way of example, will now be described with reference to the accompanying schematic drawings wherein

Fig. 1 shows a side elevation and partly in section means including a chamber for sterile packaging in accordance with the invention; and

Fig. 2 shows the cross-section of the chamber shown in Fig. 1.

As seen in Fig. 1 prefabricated packing containers 1 are accommodated in holder devices 3 in a conveyor 2. The conveyor belt passes under a tunnel 4. As seen in Fig. 2 the tunnel is formed with a longitudinal gap or slot in its base, and the conveyor belt, including the containers, cooperates with the walls of the tunnel to form a seal closing a treatment chamber 5. In other words the conveyor belt together with the containers forms a base wall of the tunnel chamber which substantially excludes the surrounding atmosphere, the belt being formed of an appropriate material for this purpose. In the embodiment shown the conveyor belt is in the form of an endless band with openings 3 serving as holder devices for the containers. The edges of the openings are adapted to surround the outside of the container walls tightly, at least along a peripheral zone on the containers. When the containers are for

example of rusto-conical shape, the edges of the openings may be bevelled to correspond to the tapering of the containers.

In order to maintain a sterile atmosphere in the treatment chamber 5, the conveyor belt 2 is passed in and out of the tunnel through aseptic screens or curtains provided by nozzle devices 8 and 9 respectively. The screens may be formed of an air curtain consisting of a stream of sterile air, or a sealing member. The screen at the exit from the tunnel may alternatively be a liquid curtain consisting of finely distributed particles of a sterilizing, cleaning or disinfecting liquid. In the sterile chamber 5 there may also be provided devices 10 for introducing a pressure medium, e.g. compressed air, for example infiltered or sterilized condition, or a sterilizing gas to establish super-atmospheric pressure in the chamber. The containers pass beneath a device 11 which directs a sterilizing electronic beam into the interior of the chamber and sterilizes the devices and materials in and passing through the chamber. A filter 12 is provided to load the containers with sterile contents and provision may be made for the simultaneous loading of a plurality of containers. There is provided a closing device 13, which, for example, by heat and pressure, during operation of a press-on plate 14 seals cover material 15 on to the containers, so that the sterile material in the containers is enclosed. In the tunnel wall is an inlet 27 for entry of the said strip cover material.

The cover material 15 may consist of a web, for example of aluminium, or an aluminium foil laminated to a layer of paper or plastics material. The web material may be in the form of a roll 16 and prior to introduction into the treatment chamber 5 may pass through a washing and/or sterilizing operation. For this purpose a vat 17 is provided containing a washing and/or sterilizing liquid 18. For the removal of excess liquid from the web an air-blast doctor blade 19 may be provided, by means of which excess liquid is caused to flow or drip back into the vat 17. Furthermore, as shown, devices 20 and 21 may be provided adjacent to the vat, for the absorption of excess liquid, and for the heating of the web so that the remaining liquid evaporates. The web material or cover material may be introduced into a pretreatment chamber before entering into the treatment chamber 5. For the pretreatment chamber there are provided aseptic screening devices 23, 24 which consist, for example, of a sterile air stream, a liquid curtain of a sealing member. In the pretreatment chamber may also be arranged additional devices for the further cleaning and sterilizing of the web material, such as a device 25 for the irradation of the web with ultraviolet light and a device 26 ofr directing an electronic beam on to the web material. A knife or punch device 28 is provided outside the chamber for the severing of the covers from the web, leaving flaps 29. At the chamber inlet may be provided a drawing device 30 which may be connected to a vacuum source, arranged to lodge the containers 1 in a tight contact with the edges of the apertures 3 of the conveyor belt 2.

As illustrated in Fig. 2 the bottom edge zones of the longitudinal side walls of the tunnel extend downwards and converge inwards, to co-operate with the edges of the conveyor 2 to define the treatment chamber 5 and seal it against the environment. When pressure is maintained inside the treatment chamber edges of the conveyor belt 2 may be in the form of a substantially sealing bevel or taper against the inwards sloping sidewall portions 32 of the tunnel. The conveyor belt may be specifically shaped to ensure a tight seal, e.g. the longitudinal side edges of the conveyor belt may be bent down, as shown at 34. Alternatively a sealing member 33 may be provided so that it can co-operate more definitely with the sidewalls of the tunnel.

When using the arrangement described the method to be followed is as follows: Preformed containers 1^1 are placed in the holder apertures 3 of the conveyor belt 2 so that the containers, seal the openings and ensure that the conveyor belt together with the containers can constitute a wall unit for the base of the treatment chamber 5. The containers are carried by the belt 2 into the treatment chamber through the opening 6 and through the aseptic screen from the nozzle device 8 which prevents the atmosphere surrounding the chamber from entering the treatment space. The screen may alternatively be provided by a source of radiation which discharges a curtain of electronic radiation, whereby the containers, the conveyor belt and the area of the opening 6 of the chamber are subjected to simultaneous sterilization. If the screen is not of electronic character, the containers 1 and the conveyor belt 2 are sterilized in the treatment chamber 5 by electronic discharge from a radiation element 11, whereby at least those parts of the containers and of the conveyor belt which are inside the chamber, and adjoin the chamber, are sterilized. Specifically the insides of the containers are rendered sterile.

The radiation device may be adapted to emit a curtain of high-energy electrons. Preferably the electronic radiation is of such high energy (between 1 and 10 million electron volts) that the packing containers are sterilized both on their insides and their

outsides on account of the radiation penetrating through the walls of the containers. In many cases this is the only way of making sure that no re-infection of the insides of containers, sterilized earlier, is present when the containers are loaded wih the intended contents and closed. In addition to sterilization of at least the surface area of the conveyor exposed directly to the electronic radiation, those parts which are covered or shaded by the containers will also be sterilized by the penetrating radiation. Furthermore, a sterilizing effect is achieved on the underside of the conveyor belt, on the insides of the treatment chamber and on the devices located in the chamber, such as filling and closing devices, owing to the high-energy electrons from the radiation source and scondary radiation from collisions with air molecules.

In the treatment chamber 5 a sterile atmosphere is maintained by the introduction into the chamber, as mentioned previously, of sterile-filtered air or gas. By this a small super-atmospheric pressure may be maintained in the chamber, which prevents any air contaminated with bacteria from entering the chamber, especially through its inlet and outlet openings 6, 7, 22 and 27.

The packing containers 1, after they have been sterilized, are advanced to the filler 12, where they are loaded with the material being packed, (which material may be introduced into the treatment chamber 5 in a sterile condition or which may be sterilised before discharge into the containers, by electronic bombardment in the chamber). After loading the containers are hermetically sealed by cover blanks from the web 15 fed into the chamber, the covers being sealed down by a closing tool 13, preferably against the rims of the containers, during the application of heat and pressure. The loading and closing operations may be carried out while the containers are stationary, or while being moved at uniform speed through the tunnel.

The strip 15 for the cover blanks may pass through a washing and/or sterilizing operation before entering the treatment chamber, and/or may be sterilized by an electron discharge in the chamber. The strip material, as illustrated schematically in Fig. 1 is affixed as a cover to the container mouths and the spacing between the containers allows the closed containers easily tob e moved out of the chamber through the opening 7 without the surrounding atmosphere being able to enter the treatment chamber. The containers are simply moved out of the chamber through an aseptic screen provided by the nozzle device 9, which, when the conveyor belt runs horizontally, may consist of a vertical air curtain, or a liquid curtain, or a sealing member. The knife or punch 28 is located outside the chamber to sever the containers from one another and to cut off excess material of the cover blanks. By a simiple shaping of the same punching tool a grip lug 29 may be produced in the cover blank to facilitate the opening of the containers. The separate containers are finally removed for further processing, e.g. packing into transport crates or cases.

Without departing from the scope of the invention modification of the method and apparatus described above may be adopted. Thus the conveyor belt 2 and the prefabricated containers 1 may be subject to a pretreatment in the form of washing and/or sterilising before introduction into the treatment chamber 5. Furthermore, the holder device 3 in the conveyor belt may be of different form, for example as recesses or depressions in the belt. The longitudinal edges of the conveyor belt may also be designed in various ways to facilitate the tight contact of the belt edges against the insides of the longitudinal side walls of the tunnel. The treatment chamber 5 may be of any suitable form, and it may thus differ appreciably in its shape from that described and illustrated. The devices 8, 9, 23 and 24 providing screens or curtains may be of any suitable form adapted to prevent the surrounding atmosphere from entering the treatment chamber 5, and pretreatment chambers (if provided), or to provide a sterilising effect on the containers and the conveyor belt. The sterile condition of the atmosphere is further safeguarded by maintenance of a super-atmospheric pressure in the chamber. The conveyor belt in its simplest form consists of an endless band of material, and may be operated for the continuous or intermittent transport of the containers. By utilising a conveyor belt as a holder for the pre-fabricated containers 1 it is possible, by modifying the holders 3, to ensure containers are suitably positioned vertically having regard to their configuration, the structural design of the tunnel 4 and the treatment operations.

WHAT WE CLAIM IS:—

1. Apparatus for the sterile packaging of fluent material comprising a tunnel with a longitudinal gap in its base, an endless conveyor provided with apertures adapted to be sealed by containers tightly fitted therein, or with imperforate recesses or depressions for holding containers, which conveyor transverses said base gap of said tunnel with its edges in co-operation with the tunnel walls in order, when loaded with containers, to form a seal across said gap, aseptic screening means at spaced positions defining between them a closed sterilised space within the tunnel through which said

containers are carried by said conveyor, said aseptic means at the entrance into, or additional means within, said space comprising means for directing a sterilizing beam of electrons upon said containers during or after entry into said space, means in said space for loading the sterilized containers with their intended sterile contents, and means in said space for closing and sealing the loaded containers before they are carried out of said space through the other of said aseptic screening means.

2. Apparatus as claimed in Claim 1 wherein the tunnel walls and the conveyor edges are shaped to make slidable sealing engagement with one another.

3. Apparatus as claimed in Claim 2 wherein the side walls of the tunnel converge downwardly upon one another, and the conveyor edges are correspondingly bevelled or folded.

4. Apparatus as claimed in any preceding claim wherein said aseptic screening means at the entrance into said space are adapted to emit a curtain of sterilie air or gas, or of sterilising liquid droplets.

5. Apparatus as claimed in any of Claims 1—3 wherein said aseptic screening means comprise a sealing member.

6. Apparatus as claimed in any preceding claim comprising means for maintaining super-atmospheric pressure in said space.

7. Apparatus as claimed in Claim 6 wherein there is provided a passage communicating with said space through which sterile air or gas under pressure is introduced therein.

8. Apparatus as claimed in any preceding claim wherein said beam of electrons is provided by an electronic discharge device adapted to direct the beam to the mouths of the containers and the inner conveyor surface in said space.

9. Apparatus as claimed in Claim 8 wherein the electronic discharge device is adapted to provide a beam of high-energy electrons adapted to penetrate the containers and the conveyor.

10. Apparatus as claimed in any preceding claim comprising a delivery pipe passing through the tunnel roof and adapted to deliver liquid material for packaging to the sterilised containers in the tunnel.

11. Apparatus as claimed in Claim 10 wherein the delivery pipe is adapted to deliver liquid to a plurality of containers simultaneously.

12. Apparatus as claimed in any preceding claim comprising means for sterilising container-covering material in the course of passage into said space.

13. Apparatus as claimed in Claim 12 comprising means for supporting a roll of container-covering strip material outside the tunnel, a sterilising enclosure mounted on the tunnel and in communication with the tunnel, means in said enclosure for sterilising said strip material passing therethrough, and means for guiding the strip from its roll, through said enclosure and into the tunnel.

14. Apparatus as claimed in Claim 13 comprising a bath of sterilising liquid through which the strip passes during its progress to the tunnel.

15. Apparatus as claimed in Claim 14 comprising drying means for drying the strip after its immersion in said bath.

16. Apparatus as claimed in Claim 13, 14 or 15 comprising ultra-violet radiation sterilising means for the strip in said enclosure.

17. Apparatus as claimed in any of Claims 13—16 comprising in said enclosure electronic discharge means adapted to direct a beam of electrons on to said strip in order to sterilize it.

18. Apparatus as claimed in any preceding claim comprising, in said space, a tool adapted to apply pressure and heat to affix covers to said containers after loading.

19. Apparatus as claimed in any preceding claim comprising cutter means outside the tunnel adapted to separate the loaded and sealed containers from one another.

20. A method of aseptic packaging substantially as described herein with reference to the accompanying drawings.

21. Apparatus for aseptic packaging substantially as described herein with reference to accompanying drawings.

22. An aseptic package whenever made by the method, or by use of apparatus substantially as described herein with reference to the accompanying drawings.

W. H. BECK, GREENER & CO.,
Chartered Patent Agents,
7 Stone Buildings,
Lincoln's Inn,
London, WC2A 3SZ.
Agents for the Applicants.

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1470990 COMPLETE SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

Fig. 1

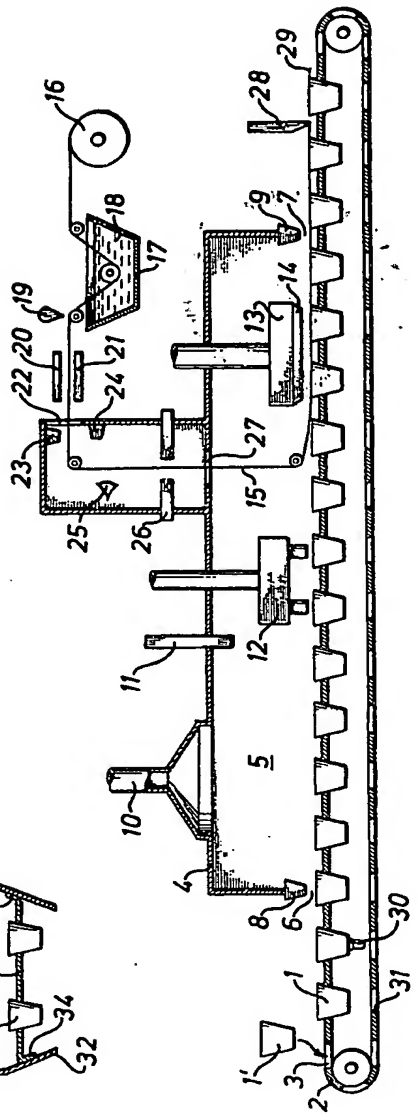

Fig. 2